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THE CLAIMS OF LONG DESCENT.

Vorträge über botanische Stammesgeschichte, gehalten an der Reichsuniversität zu Leiden. Ein Lehrbuch der Pflanzensystematik. Zweiter Band, Cormophyta Zoidogamia. By Dr. J. P. Lotsy. Pp. 902. (Jena: Gustav Fischer, 1909.) Price 24 marks.

THE expectations aroused by the first volume of this work, which dealt with the Thallophyta, will not be disappointed by that now issued, in which are included the liverworts, mosses, ferns and fern-allies, and also the seed-producing plants that possess ciliated male cells. In its wide compass are thus at the one extreme types of a very low grade of complexity, while at the other stands Ginkgo, long regarded as a true conifer. The endeavour to trace the ancestry of the types in this range of forms raises many of the most interesting and suggestive problems in systematic botany, towards the answers to some of which much progress has been made in recent years.

The contributions to their solution have been made in a literature so scattered, and in so many languages, that much of what has been published is difficult of access, and is apt to remain unknown to students; hence the gain is great when it is collected, analysed, and presented in clear and systematic form, especially when accompanied, as it is here, with an excellent bibliography and ample references to the original sources of information. Such a work as this must necessarily be very largely a compilation if it gives an adequate statement of the present state of knowledge and of the explanations put forward upon many disputed questions; but the author has added to its value by discussing these questions and stating the reasons for and against the solutions advanced.

While indication of relationships and of lines of descent is, as the title of the book implies, a prominent feature throughout, its scope is much wider than this, so that it is an admirable handbook to the study of the structure and life-cycles of the groups discussed in it.

In a brief review it is not possible to note more than a few of the many questions that arise in the consideration of the plants included in this volume. These plants agree in showing a cycle in which there is a marked contrast between the gametophyte and the sporophyte, or the x - and the $2x$ -generations, as Dr. Lotsy prefers to express them; and they also have the archegonium recognisable, though obscured among the higher forms. The two great divisions of Haplodiales and Diploidales, characterised by the dominance of the x - and the $2x$ -generations respectively, express the recognition that recent discoveries have shown clearly the intimate relationships between the ferns and the seed-plants. After discussing the hypotheses with regard to the origin of the Haplodiales and Diploidales, the author supports the view that they are derived by independent lines from Algae of the group Isokonta. As to the origin of the anthetic generations in the cycle, he holds that the evidence does not warrant a dogmatic conclusion; but

in discussing the homologies of leaf and stem in the Diploidales he inclines to Potonié's hypothesis that both represent specialised parts of a thallus, and may be homologous with one another. Among the Haplodiales the evidence points more directly to the same conclusion.

The structure and life-histories of a typical moss and of a typical fern are set in contrast; and then follows a similar account of a very simple (? primitive) type of each, to ascertain in how far the supposed algal ancestry can be traced. Then follows a survey of the genera under each division, including every genus that shows features of importance or interest, morphological or biological; and not a few questions of wider than mere systematic value are discussed clearly and helpfully, as they arise in connection with certain forms, e.g. under Hepaticæ are discussed the suggestion that Anthoceros may represent a stage in the development of the sporophyte in Diploidales, the origin of the foliose habit, adaptations for economising water in various types, the influence of light on dorsiventral structure, &c. The wide range of structure and of adaptability among Hepaticæ is emphasised as in marked contrast to the relative fixity of type among the true mosses; but among the latter many features of biological import are duly noticed, such as the methods of vegetative multiplication, and their relation in frequency to the greater or less difficulty in securing the union of the male with the female cells.

The classification of the mosses into Acrocarpi and Pleurocarpi is held to be too artificial, as is also the importance attached to the rupture of the capsule in the normal manner by a lid, those forms in which the lid is not broken away being regarded as not forming a related group, but rather as aberrant from various families. Examples are quoted of very long-continued vitality in the spores of certain mosses, up to fifty years in a species of *Edipodium*. The enlargement and flattening of the apophysis in *Splachnum*, and the growth of root-hairs from the seta in *Eriopus*, may be regarded as efforts on the part of the sporophyte to provide nourishment for itself; but they only emphasise the dependence of the sporophyte upon the gametophyte among the mosses.

In sharp contrast to them, in this respect, stand the vascular plants or Diploidales, although for a brief period, during early germination, the sporophyte fern is as dependent on the gametophyte for nutrition as is the moss-capsule. The dominance of the sporophyte becomes always more evident as the adaptation to life as land-plants becomes more complete, and as the dependence on surface-water to allow of fertilisation of the ovum is done away with, until in the Angiosperms it becomes difficult to trace the gametophytes with certainty, and the sporophytes appear to be themselves sexual, as was long the interpretation of the structure of flowers.

Dr. Lotsy gives a very helpful explanation of the discoveries that in recent years have thrown so much light on the affinities of the great divisions of the Diploidales, and have broken down the distinction between Phanerogamia and Cryptogamia, discoveries in which the English-speaking races have taken so great

a part. It is now evident that the tendency to retain the megasporangium within the sporangium, and to continue to nourish the gametophyte and also its offspring, the sporophyte, through the sporangium until the young sporophyte is provided with sufficient food in reserve to enable it to begin life on its own account with a fair prospect of success, resulting in the production of the seed, has originated in widely different types, and therefore on independent lines. Thus the true significance of the seed, as an adaptation to secure the fuller possession of the earth's surface, and to escape the dangers of dependence on water for the fertilisation of the egg-cell, has become realised. A new era in botany opened with the recognition of the common ancestry of ferns and cycads, based on similarities in their structure, by the discovery that supposed ferns of the Carboniferous strata produced true seeds resembling those of cycads in important respects, and on the not less startling discovery, which we owe to Japan, of the ciliated male cells in the pollen of *Ginkgo* and of the cycads. Of these and other great advances in recent years, such as in the knowledge of the Cycadeoidea, Dr. Lotsy gives a very clear account, which should be most helpful to students.

The vascular plants possessed of ciliated sperms, the Zoidogamia, he divides into two great groups characterised by the sperm-cells, which possess two cilia in the Lycopodineæ and their allies, and many cilia in the Filicineæ and seed-formers. He points out that this agrees with the groups based by Lignier on the structure of the leaves. Heterospory has been attained independently in several lines of descent in both these groups, and is thus no certain proof of close relationship among plants in which it occurs. His arrangement is in several respects a good deal different from that in use in English text-books, both in the relations of the larger divisions and in such minor details as breaking up Hydropterideæ and placing Marsiliaceæ beside Schizæaceæ, and Salviniaceæ beside Hymenophyllaceæ, among the leptosporangiate filices.

On similar grounds *Selaginella* is brought back to Lycopodiaceæ, while *Isoetes* is placed between the Equisetaceæ and Filices, because of its polyciliate male cells and of the development of its spores and embryo. The present state of knowledge with regard to the structure and life-histories of the Lycopodiaceæ and their allies is in striking contrast to that of not many years back; and of this advance the author gives a good account. The relations of the alliance to other groups can now be estimated in a truer light than was formerly possible. Though certain types within it had advanced far on the way to the formation of seeds, there is no clear evidence pointing to the descent from them of any existing seed-plants.

The lectures treating of the ferns and their allies are of very special interest, in view of the ever-increasing evidence connecting them with the descent of the seed-plants. While the progress during the past decade has been very great, and has revolutionised former beliefs, it has shown also that the production of seeds had already been attained at a period so far back in geological history as to make it very improbable that direct proof of the lines of evolution will

be obtained. But while great problems will probably remain unsolved in detail, the general trend of progress has become evident, and there is reason to anticipate that the rate of advance will not slacken; though it seems scarcely likely that there can be many future discoveries so startling as those already alluded to.

The grouping of the leptosporangiate ferns takes full account of Prof. Bower's researches on the sporangia. The eu-sporangiate types, like the leptosporangiate, are derived from the Primo-filices, by separate lines of descent. The Pteridospermeæ are probably more nearly related to Marattiaceæ than to any other existing ferns, but over a very wide gap. The concluding lectures of this volume treat of the Cordaitales, Bennettiales, Cycadales living and extinct, and Ginkgoaceæ. They present subjects of extreme interest, and of the utmost importance in tracing the development of the higher plants.

Those who read this volume will feel that while it demands close attention, and while some of the lectures are of value for reference on subordinate groups rather than for questions of wider interest, the work well repays the attention necessary, and that the aim, kept steadily in view, has been successfully attained, to supply an unbiased and worthy representation of what is at present known with regard to the groups of plants discussed. The information brought together within its compass has been gathered from a vast field; and the sources from which it has been taken are scrupulously indicated, as regards both text and the excellent and copious illustrations, which do much to aid the exposition, clear though that is. We cannot but feel that it is more useful in its present form, available to be read and re-read, than it could be as a course of lectures. It must prove a great boon to students desirous to obtain an adequate guide to the researches of recent years, in a form that can permit of use as a work of constant reference, from which they may gain wider views of the science of botany.

The third volume, on siphonogamous seed-plants, will be most welcome, though it can scarcely deal with subjects of such interest, or so full of the charm of advancing knowledge. The standard of the two volumes already published is a guarantee for the expectation that it will be a most valuable addition to every botanical library.

UTILISATION OF PEAT.

Commercial Peat: its Uses and Possibilities. By F. T. Gissing. Pp. x+191. (London: Charles Griffin and Co., Ltd., 1909.) Price 6s. net.

IN this volume on peat, which is a companion one to that published in 1907 by Messrs. Björling and Gissing, the author's aim is the description, from a commercial point of view, of the various processes proposed for the utilisation of peat.

In pursuance of this object Mr. Gissing describes fully the preparation from peat of alcohol, moss litter, and paper, the cutting and drying of peat, and the manufacture of press turf and of machine turf, but the greater part of the book deals with the products got by the destructive distillation of peat.